

IN THE CLAIMS:

Please amend claims 22-25, 58-59, and 97 as follows.

1-5 (Cancelled)

6. (Withdrawn) The working planning method according to claim 5, wherein said working area has a square frame orthogonal to said first and second directions.

7. (Withdrawn) The working planning method according to claim 5, wherein said first and second directions are set to correspond to the moving direction of a workpiece.

8-10 (Cancelled)

11. (Withdrawn) The working planning method according to claim 10, wherein said area placement is provisionally determined by a method comprising the steps of:

provisionally setting a next working area so as to enclose an end point in a first direction not yet enclosed by the working area;

moving said provisionally set working area in a second direction different from said first direction to enclose an end point in the second direction;

again moving said moved working area in the first direction so as to enclose the end point in said first direction in positions after the movement; and

again moving the re-moved working area in the second direction so as to enclose the end point in said second direction in positions after the re-movement, wherein

said steps of moving are repeated to define the next working area.

12. (Withdrawn) The working planning method according to claim 10, wherein said area placement is provisionally determined by a method comprising the steps of:

simply dividing an entire surface of the workpiece into the working areas; and

subsequently removing all the working areas without any working position.

13. (Withdrawn) The working planning method according to claim 10, wherein said area placement is provisionally determined by a method comprising the step of:

repeating the step of placing a working area in a position with a largest number of working positions not yet enclosed until all the working positions are enclosed.

14. (Withdrawn) The working planning method according to claim 10, wherein said working area is shifted to a neighborhood and an unnecessary neighboring area is removed, provided that a point independently belonging to said working area stays within the area.

15. (Withdrawn) The working planning method according to claim 10,
wherein among said working areas, at least two areas joined at an overlapping
location are each shifted to a neighborhood and an unnecessary neighboring area is
removed, provided that a point independently belonging to said at least two areas stays
within said working areas.

16 (Cancelled)

17. (Withdrawn) The working planning method according to claim 16, wherein
some of the working positions belonging to said plurality of areas are allocated to
an area having a greater difference among a plurality of simultaneous working areas,
some of the remaining working positions are allocated to a area having a smaller
difference, and
eventually remaining working positions are distributed equally among both areas.

18 (Cancelled)

19. (Withdrawn) The working planning method according to claim 18, wherein
area position is adjusted so that center of an extent of said working positions matches
center of the working area.

20. (Withdrawn) The working planning method according to claim 18, wherein area position is set as near as center of gravity of the working positions, provided that the working positions are within the working area.

21 (Cancelled)

22. (Currently Amended) A working ~~planning~~ method in simultaneously working on a workpiece placed on a movable stage by a plurality of working units capable of scanning or moving working means within a working area, said method comprising the steps of:

determining ~~an interval~~ a distance between the working units so that a number of scanning or moving the working means or a number of moving the stage is minimized;

and

working on a workpiece based on a result of said determining.

23. (Currently Amended) The working ~~planning~~ method according to claim 22, wherein the number of scanning or moving said working means and the number of moving the stage are weighted depending on difference in scanning time as compared to ~~or~~ moving time.

24. (Currently Amended) The working ~~planning~~ method according to claim 22, further comprising the steps of:

setting ~~the an interval of time~~ a distance of said working ~~means~~ units;

overlapping scanning or moving ranges of the working units at that time, thereby obtaining area placement to minimize number of working areas; and

calculating the number of scanning or moving of the working means and the number of moving the stage at the time.

25. (Currently Amended) A working ~~planning~~-method, comprising the steps of:

performing the determining the distance between the working units so that the number of scanning or moving the working means or a number of moving the stage is minimized ~~process~~-according to claim 22 in a first workpiece direction and subsequently in a different second workpiece direction different from the first workpiece direction; and

automatically employing ~~the a~~ a workpiece direction, selected from the first workpiece direction and the second workpiece direction, which minimizes the number of scanning or moving the working means or the number of moving the stage.

26 (Cancelled)

27. (Withdrawn) The working planning method according to claim 26, wherein said tree is a k-dimensional binary search tree.

28. (Withdrawn) The working planning method according to claim 26, wherein said tree is used to list point data in each working area after the position of working areas scattered on the workpiece is determined.

29. (Withdrawn) The working planning method according to claim 26, wherein from a root node of said tree, for internal nodes, whether or not to search a child node of a node is judged based on the degree of overlapping between a region corresponding to the child node of the node and a search region, and only when a leaf node is reached, the point data is directly accessed.

30. (Withdrawn) The working planning method according to claim 26, wherein process of searching nearest neighbor point to a point of interest is conducted using said tree.

31. (Withdrawn) The working planning method according to claim 30, wherein said process of searching the nearest neighbor point is started from a root node of said tree.

32. (Withdrawn) The working planning method according to claim 31, wherein a node is searched when a circle centered on the point of interest and having a radius as long as distance to present nearest neighbor point overlaps a region corresponding to the node.

33. (Withdrawn) The working planning method according to claim 32, wherein if said node is a leaf node, distances to all the points corresponding to the node in the region are obtained, and it is judged whether each distance is short.

34. (Withdrawn) The working planning method according to claim 30, wherein each point data piece has information related to a leaf node to which said data piece belongs,

said process of searching the nearest neighbor point is performed by directly accessing the leaf node having the point of interest whose nearest neighborhood is searched, and then the search is performed in a direction toward the root node of said tree, only if there is a node to be searched.

35. (Withdrawn) The working planning method according to claim 34, wherein if a circle centered on the point of interest and having a radius as long as distance to present nearest neighbor point and a region corresponding to a node are outside a

region corresponding to the present node, a brother node thereof or a brother node of a parent node thereof is searched depending on a degree of how much outside they are.

36. (Withdrawn) The working planning method according to claim 30, wherein said process of searching said nearest neighbor point and process of searching next nearest neighbor point, using a tree removed of a found nearest neighbor point are repeated, so that neighbor points are listed in order of their nearness to the point of interest.

37. (Withdrawn) The method of working planning according to claim 30, wherein process of searching the nearest neighbor point not yet connected to a working path by said process of searching the nearest neighbor point and connecting a new found point of interest to the working path, and process of searching next nearest neighbor point using the tree removed of the found point of interest and connecting a next new found point of interest to the working path are repeated from a start point to an end point to produce the working path.

38. (Withdrawn) The working planning method according to claim 36, wherein the process of removing a found point from said tree is performed by reducing ending number of an index attached to each point data or by increasing starting number.

39. (Withdrawn) The working planning method according to claim 38, wherein if a found point is removed from said tree, and all point data in a node disappears, the node is attached with information indicating that it is not necessary to visit the node.

40. (Withdrawn) A working planning method, wherein a working path determined by a working planning method according to claim 37 is set as an initial solution in determining order of working by applying a traveling salesman problem.

41 (Cancelled)

42. (Withdrawn) The working planning method according to claim 41, wherein said process of searching a set of areas having relatively matched point data placements is performed by the steps of:

producing point position data by adding a prescribed coordinate shift to all the points in one area;

visiting one node after another corresponding to a region having said point position data from a root node of a tree in the other area; and

checking whether or not there is point position data matched with said point position data only when a leaf node is reached.

43. (Withdrawn) The working planning method according to claim 26, wherein

in the process of enclosing point data in the working area with the minimum number of equal size rectangles,

every time a provisional working area is produced by calling a loop, said tree is built both for the provisional working area and provisional point position data in each working area.

44. (Withdrawn) The working planning method according to claim 26, wherein said tree is built both for the working area and point position data in each working area when the working area is defined.

45. (Withdrawn) A working method performing working determined by the working planning method according to claim 1.

46. (Withdrawn) A computer program for implementing the working planning method according to claim 1.

47-57 (Cancelled)

58. (Currently Amended) A working planning device for planning working in working on a workpiece placed on a movable stage simultaneously using a plurality of working units capable of scanning working means in a working area, comprising,

unit ~~interval~~ distance determining means for determining ~~an interval~~ a distance of the working units so that a number of scanning or moving the working means or a number of moving the stage is minimized; and

output means for providing a plan to be used for working on a workpiece,
wherein, if the unit distance determining means and the output means are implemented in software, the software is embodied on a computer readable medium.

59. (Currently Amended) The working planning device according to claim 58, further comprising,

workpiece direction determining means for performing the ~~processing~~ determining the distance of the working units so that the number of scanning or moving the working means or the number of moving the stage is minimized by said unit ~~interval~~ distance determining means in a ~~different~~ second workpiece direction different from a first workpiece direction used by the unit distance determining means, and automatically employing a workpiece direction, selected from the first workpiece direction and the second workpiece direction, allowing the number of scanning or moving the working means or the number of moving the stage to be minimized.

60 (Cancelled)

61. (Withdrawn) A working device comprising the working planning device according to claim 47.

62. (Withdrawn) A computer program for implementing the working planning device according to claim 47.

63 (Cancelled)

64. (Withdrawn) The working data producing method according to claim 63, wherein

said working plan is determined by a method comprising the steps of:

determining an optimal working path for working positions in each working area;

and

subsequently determining order of working at the working positions in each working area so that the total working time is minimized in the working areas to be simultaneously worked.

65. (Withdrawn) A computer program for implementing the working data producing method according to claim 63.

66 (Cancelled)

67. (Withdrawn) The working data producing device according to claim 66,
wherein
said working plan is determined by a method comprising the steps of:
determining an optimal working path for working positions in each working area;
and
subsequently determining order of working at the working positions in each
working area so that the total working time is minimized in the working areas to be
simultaneously worked.

68. (Withdrawn) A computer program for implementing the working data
producing device according to claim 66.

69. (Withdrawn) A computer readable recording medium recorded with the
computer program according to claim 46.

70. (Withdrawn) The working planning method of claim 24, further comprising:
determining an optimal working path for working positions in each working area;
and

subsequently determining order of working at the working positions in each working area so that the total working time is minimized in the working areas to be simultaneously worked.

71. (Withdrawn) The working planning method of claim 24, further comprising:
shifting an start point of a working path in each of the plurality of simultaneous working areas so that time for scanning or moving simultaneously performed can be equal, thereby shortening a total working time.

72. (Withdrawn) The working planning method of claim 24, further comprising:
solving the traveling salesman problem, thereby minimizing a length of a tour; and
subsequently detecting a longest movement, and determining start and end points so that the longest movement is removed.

73. (Withdrawn) The working planning method of claim 24, further comprising:
solving a traveling salesman problem to minimize a value produced by removing a longest movement from a tour, thereby obtaining a new tour, and
eventually removing the longest movement, and determining start and end points.

74. (Withdrawn) The working planning method of claim 24, further comprising:

provisionally setting a next working area so as to enclose an end point in a first direction not yet enclosed by the working area;

moving said provisionally set working area in a second direction different from said first direction to enclose an end point in the second direction;

again moving said moved working area in the first direction so as to enclose the end point in said first

direction in positions after the movement; and again moving the re-moved working area in the second

direction so as to enclose the end point in said second direction in positions after the re-movement, wherein

said steps of moving are repeated to define the next working area.

75. (Withdrawn) The working planning method of claim 24, further comprising: simply dividing an entire surface of the workpiece into the working areas; and subsequently removing all the working areas without any working position.

76. (Withdrawn) The working planning method of claim 24, further comprising: repeating the step of placing a working area in a position with a largest number of working positions not yet enclosed until all the working positions are enclosed.

77. (Withdrawn) The working planning method of claim 24, further comprising :

provisionally determining area placement; and
subsequently shifting a working area to a neighborhood and removing an
unnecessary working area.

78. (Withdrawn) The working planning method of claim 24, further comprising,
when the same working position belongs to a plurality of areas, determining said
areas to be worked so that number of working positions belonging to each of a plurality
of simultaneous working areas is equal.

79. (Withdrawn) The working planning method of claim 24, further comprising:
adjusting an area position so that working positions are gathered to center of each
working areas.

80. (Withdrawn) The working planning method of claim 24, further comprising:
determining a moving path for said stage by solving a traveling salesman problem
with fixed edge points in which a position to load the workpiece to the stage from a
loader is set as a start point of the moving path for said stage, a position before moving
the workpiece to an unloader is set as an end point.

81. (Withdrawn) The working planning method of claim 24, wherein point position data representing working positions or working areas scattered on the workpiece is expressed in a tree type data structure.

82. (Withdrawn) The working planning method of claim 24, wherein an unnecessary, high load operation is removed by finding a set of areas in which placement of point data in one of the working areas and placement of point data in another working area are relatively matched.

83. (Withdrawn) The working planning method of claim 24, further comprising:
determining a working plan based on working position data received from a working device side through a communication line; and
returning the plan to said working device side.

84. (Withdrawn) The working planning device of claim 58, further comprising:
working path determining means for determining an optimal working path for working positions in each working area; and
working order determining means for determining order
of working in the working positions in each working area so that the total working time in the working areas to be simultaneously worked is minimized.

85. (Withdrawn) The working planning device of claim 58, further comprising:
working order shift means for shifting a start point of a working path for each of the plurality of simultaneous working areas so that time for scanning or moving performed simultaneously can be equal among the simultaneous working areas, and shortening the total working time.

86. (Withdrawn) The working planning device of claim 58, further comprising:
scanning path determining means for detecting a longest movement after minimizing a round path by solving the traveling salesman problem, and determining start and end points so that the longest movement is removed.

87. (Withdrawn) The working planning device of claim 58, further comprising:
scanning path determining means for solving a traveling salesman problem improved to minimize a value produced by removing longest movement from a tour, thereby obtaining tour, and eventually removing the longest movement to determine start and end points.

88. (Withdrawn) The working planning device of claim 58, further comprising:
area placement determining means for repeating a process for defining a next working area,

said process including provisionally setting the next working area so as to enclose an end point in a first direction not yet enclosed by the working area; moving the provisionally set working area in a second direction different from the first direction so that the area encloses an end point in the second direction; again moving said moved working area in the first direction so that the area encloses the end point in said first direction, and again moving said removed working area in said second direction so that the area encloses the end point in said second direction in a position after the re-movement.

89. (Withdrawn) The working planning device of claim 58, further comprising:
area placement determining means for simply dividing an entire surface of a workpiece into working areas, and removing all the working areas having no working position.

90. (Withdrawn) The working planning device of claim 58, further comprising:
area placement determining means for repeating a process of placing a working area in a position having the largest number of working positions not yet enclosed until all the working positions are enclosed.

91. (Withdrawn) The working planning device of claim 58, further comprising:

area placement determining means for provisionally determining area placement, shifting a working area to a neighborhood, and removing an unnecessary working area.

92. (Withdrawn) The working planning device of claim 58, further comprising:
belonging area determining means for determining a working area, when same working positions belong to a plurality of working areas, said means determining the areas so that number of working positions belonging to each of the plurality of simultaneous working areas is equal.

93. (Withdrawn) The working planning device of claim 58, further comprising:
area placement adjusting means for adjusting area positions so that working positions are gathered around the center of each working area.

94. (Withdrawn) The working planning device of claim 58, further comprising:
moving path determining means for determining a moving path for said stage by solving a traveling salesman problem with fixed edge points wherein a position to load a workpiece to the stage from a loader being set as a start point of the moving path for said stage, a position before transferring the workplace to an unloader being set as an end point.

95. (Withdrawn) The working planning device of claim 58, further comprising:

means for storing point position data on points representing working positions or working areas scattered on the workpiece, said data being expressed in a tree type data structure; and

means for determining working area positions and/or order of working using the position data expressed in said tree type data structure.

96. (Withdrawn) The working planning device of claim 58, further comprising:

means for receiving working position data from a working device side through a communication line;

planning means for determining a working plan based on the received working position data; and

transmission means for transmitting the determined working plan back to said working device side.

97. (Currently Amended) The working ~~planning~~ method of claim 24, further comprising:

performing the process according to claim 24 in a first workpiece direction and in a second ~~different~~ workpiece direction different from the first workpiece direction; and

automatically employing the workpiece direction, selected from the first workpiece direction and the second workpiece direction, that minimizes the number of scanning or moving the working means or the number of moving the stage.